Hyperkalaemia in Neonates

Guideline Responsibilities and Authorisation

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Target Audience	Consultants, Nurse Practitioner, Clinical Nurse Specialist, Registrar
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Guideline Review History

Version	Updated by	Date Updated	Summary of Changes
3	David Bourchier	Nov 2015	New format
4	Anja Hale	Nov 2023	Protocol renamed and broadened to Hyperkalaemia in neonates Inclusion of management flowchart

Hyperkalaemia in Neonates

Contents

Hyperkalaemia in Neonates

1 Overview

1.1 Purpose

To identify and treat hyperkalaemia.

1.2 Scope

All of Te Whatu Ora Waikato medical and nursing staff working in NICU.

1.3 Patient / client group

Babies and infants in NICU.

1.4 Definitions and acronyms

Euglycaemia	A normal level of glucose in the blood.
Hyperkalaemia	Hyperkalaemia is defined as a serum potassium concentration greater than 6.5 mmol/L and can lead to significant hemodynamic and neurologic consequences, whereas levels exceeding 8.5 mmol/L can cause respiratory paralysis, cardiac arrest and can quickly be fatal.
Oliguric	The production of abnormally small amounts of urine <0.5-1mL/kg/h.
NOHK	Non – oliguric hyperkalaemia a frequently observed electrolyte imbalance in premature infants with a gestational age <28 weeks during the first days of life which has the potential to cause serious complications (fatal cardiac arrhythmia, periventricular leukomalacia, brain haemorrhage, and even sudden death).
PVL	Periventricular Leukomalacia - An ischaemic brain injury typically seen in preterm infants as part of cranial ultrasound screening.
Very Preterm infant	Born ≤ 32 weeks gestation

2 Clinical management

2.1 Competency required

Able to recognise signs of hyperkalaemia

- Hyperkalaemia is defined as a serum potassium concentration greater than 6mmol/L.

  NB: Hyperkalaemia is common when capillary blood samples are haemolysed. The first step should be to confirm high serum potassium with a non-haemolysed venous or arterial sample.

- ECG changes (peaked T waves, broad QRS complexes, and arrhythmias) in the presence of serum potassium <7mmol/L which can indicate significant hyperkalaemia and require urgent treatment with calcium gluconate

3 Guideline

3.1 Aetiology of hyperkalaemia

- Hyperkalaemia in the NICU is most commonly associated with non-oliguric hyperkalaemia in the first 72 hours after birth of the very preterm infant. Immature function of the erythrocyte Na/K - ATPase is believed to be the reason for non-oliguric hyperkalaemia. Antenatal steroids may reduce incidence by enzyme maturation
- Oliguric renal failure (e.g. due to hypoxic event, drug error or renal tubular acidosis) or haemolysis are other causes for hyperkalaemia.
- Hyperkalaemia is believed to be exacerbated by:
  - Metabolic acidosis, due to exchange of intracellular potassium with extracellular hydrogen ions
  - Renal impairment
  - Hypovolaemia

3.2 Treatment

Appendix A

Hyperkalaemia is a life threatening condition and needs to be managed promptly and aggressively.

Confirm true potassium level by repeating urgent free flowing venous or arterial sample along with a simultaneous blood gas machine analysis to give an instant guide.

Consider placing peripheral or central arterial access for ongoing monitoring of TRUE potassium levels.

If you are considering treatment for hyperkalaemia, discuss with consultant on call.

Babies identified as having risk factors for hyperkalaemia should have regular potassium levels checked i.e. 6-12 hourly from a free flowing sample to remove the effect of haemolysis on the potassium level.

Mild hyperkalaemia: 6.5-7mmol/L

- Stop any potassium containing infusions (including IV nutrition) or medications
- Stop any potassium sparing diuretics e.g. spironolactone
- Correct any hypocalcaemia with 10% calcium gluconate (aim to keep ionised Ca > 1.2 mmol/l)
- Correct magnesium if <0.7mmol/L (Link to magnesium for neonates 2936)
- Treat the underlying cause of metabolic acidosis
- Correct the acidosis with sodium bicarbonate 4.2%, if the pH < 7.2 and HCO_3 < 14 mmol/L. Sodium bicarbonate and calcium gluconate should not be given through the same IV line, as there is risk of precipitation (refer Sodium Bicarbonate for neonates medicine guideline (Ref. 2963)).

- Review nephrotoxic drugs
- Avoid suxamethonium use

Moderate hyperkalaemia: 7-8 mmol/l

As above, and

- Insulin/glucose infusion (Insulin for Hyperkalaemia in neonates medicine guideline (Ref. 6422)
  - Adjust glucose infusion rather than insulin infusion to maintain euglycaemia Insulin/glucose infusion requires central venous access, as the glucose concentration is too high to be infused peripherally.
  - Insulin/glucose infusions must always be run through the same lumen to ensure both infusions stop if the line blocks or leaks.
  - Rigorous monitoring of blood glucose (as well as K+ levels) is essential as hypo/hyper glycaemia may occur.

Severe hyperkalaemia : > 8mmol/L or any raised level with arrhythmias

As above, and

- 10% calcium gluconate infusion immediately to stabilise myocardium from arrhythmias (Calcium Gluconate for neonates medicine guideline (Ref. 0596).

Salbutamol

Salbutamol is also effective in lowering the potassium by increasing cellular uptake of potassium (for 1-2 hours) and may be easier to prepare in an emergency rather than an insulin/glucose infusion (onset of action is within 5 minutes).

The use of salbutamol for NOHK in the very preterm infant is not well studied and many units would only use salbutamol as second line treatment for hyperkalaemia not responding to insulin/glucose infusion.

Salbutamol does not lower potassium level in babies with persistent metabolic acidosis (Salbutamol for neonates medicine guideline (Ref. 2960).

Removal of excess potassium

Increase urinary excretion with IV administration of furosemide 1mg/kg

Calcium resonium should only be used with extreme caution as there is the potential of rectal impaction, bowel irritability, bleeding and perforation, especially in the preterm neonate.

Persistent or refractory hyperkalaemia - Exchange transfusion, peritoneal dialysis, haemodialysis or haemofiltration

This MUST be discussed with the neonatologist on call, in consultation with the renal team at Starship Children's Hospital.

Exchange transfusions have been used but may worsen the hyperkalaemia due to the increased potassium in the donor blood.

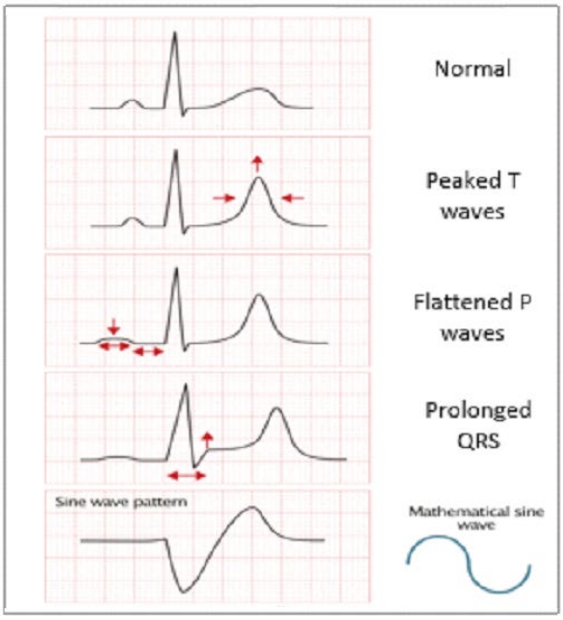
Haemodialysis or hemofiltration are not locally available and their use is limited by the time involved in transfer and preparation (Exchange and Reduction Transfusions in Neonates procedure (Ref. 1696))

3.3 Potential complications

Complications of hyperkalaemia

ECG changes:

- Peaked T-waves
- Prolonged PR interval
- Broadened QRS complexes
- Absence of the P-wave
- Arrhythmias
- Ventricular tachycardia and impaired AV conduction.
- Death



Serum potassium	ECG changes
5.5-6.5 mmol/l	Tall peaked T waves
6.5-7.5 mmol/l	Flattened P waves Prolonged PR
7.0-8.0 mmol/l	Widening of QRS
8.0-10.0 mmol/l	Sine wave, ventricular arrhythmias, AV block, asystole

The presence of ECG changes in the context of hyperkalaemia warrants immediate treatment

Complications of treatment as outlined above

- Hypo/hyperglycaemia
- Over correction of serum potassium

3.4 After care

Monitor potassium levels every 2 to 4 hours as clinically indicated and treat as appropriate

4 Audit

4.1 Indicators

There is documented evidence of:

- Serum potassium levels
- All medications given to infant
- Timely peer review of protocol

4.2 Tools

- Continuous ECG monitoring
- Serum potassium levels

5 Evidence base

5.1 Summary of Evidence, Review and Recommendations

Initial acute management of symptomatic and/or severe hyperkalemia (potassium level 6.5 mmol/L takes precedence over diagnostic evaluation. Acute management includes intravenous (IV) calcium infusion to stabilize the cardiac membrane followed by interventions that shift potassium from the extracellular space into the cells

These rapid measures are transient in nature, and it is necessary to treat any underlying reversible cause of hyperkalemia concomitantly.

5.2 Bibliography

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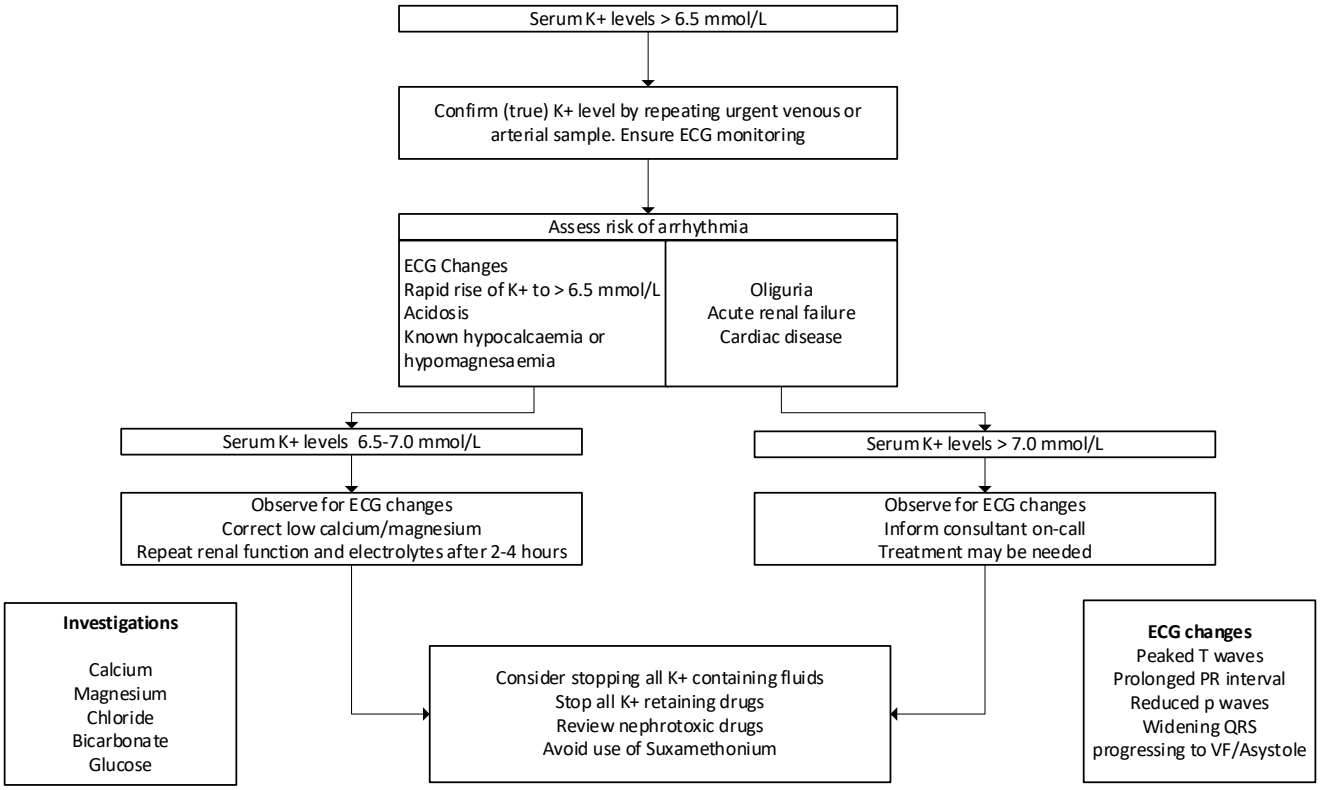
5.3 Associated Te Whatu Ora Waikato Documents

- NICU Calcium Gluconate for neonates medicine guideline (Ref:0596)
- NICU Furosemide for neonates medicine guideline (Ref.2920)
- NICU Insulin for Hyperkalaemia in neonates medicine guideline (Ref:6422)
- NICU Magnesium for neonates medicine guideline (Ref 2936)
- NICU Salbutamol for neonates medicine guideline (Ref:2960)
- NICU Sodium Bicarbonate for neonates medicine guideline (Ref. 2963)
- NICU Medical Exchange and Reduction Transfusions in Neonates procedure (Ref: 1646)

Appendix A – Management of Hyperkalaemia in Neonates flowchart



Stabilise the myocardium with 10% calcium gluconate (0.1 mmol/Kg over 10 minutes)
Ensure ECG monitoring in place

Correct the acidosis if pH <7.2 and HCO3 < 14 mmol/L
use 4.2% sodium bicarbonate 1-2mmol/Kg over 10-30 minutes
Do not give through same intravenous line as calcium as there is a risk of precipitation

First Line
if time critical

IV Salbutamol bolus (4 microgram/Kg over 5 minutes)
Dose can be repeated after 2 hours

First Line
if not time critical

Glucose – insulin administration - NOTE this is a higher dose than used for treating hyperglycaemia
insulin (0.1-0.2 unit/Kg/hr) in combination with glucose solution (5-8 mg/Kg/min) via CVAD
measure blood glucose level every 20 minutes for first hour, every 30 minutes for second hour and every 2-4 hours thereafter

Second Line

Removal of excess K+
IV Furosemide 1mg/Kg
Calcium resonium can be given rectally (term infant)

Persistent or refractory hyperkalaemia:
- advise specialist renal consultation
- consider exchange transfusion
Renal replacement therapy peritoneal dialysis, haemodialysis, haemofiltration